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AQUATIC UTRICULARIAS

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A KEY BASED UPON LEAF-CHARACTERS FOR THE AQUATIC UTRICULARIAS OF CENTRAL AND NORTHEASTERN UNITED STATES AND EASTERN CANADA

- A. Leaves all whorled U. PURPUREA Walt.
A. Leaves chiefly alternate B.
B. Foliar divisions terete C.
C. Leaves of a single type, usually three or four times, occasionally up to five or six times dichotomous, 2- or less often 3-parted D.
D. Leaves three times dichotomous: plants, if flowering, never bearing whorl of inflated petioles E.
E. Outline of leaf elliptical, due to pseudopinnate division, basal divisions about .5-.75 mm. in diameter: plant robust, stems about 1 mm. in diameter when dry and mounted, and often somewhat over 1 mm. when fresh and living U. VULGARIS L.
E. Outline of leaf circular or slightly oval, basal divisions about .25 mm. in diameter: stems under 1 mm. in diameter U. GEMINISCAPA Benj.
D. Leaves four times, occasionally up to five or six times dichotomous: flowering plants bearing a whorl of inflated petioles at about half-way up the scape; generally flowering annually F.
F. Basal divisions of leaf usually not elongate, 0+-10, commonly 3-5 mm. long, not slender, diameter .5 mm. and over: (scapes 15-33, commonly 20-30 cm. long, stout; flowers 3-14, calyx-lobes 4-6 mm. long). Restricted to southern U. S. U. INFLATA Walt.
F. Basal divisions of leaf elongate, 5-12, commonly 8-10 mm. long, slender, diameter .25 mm. and less: (scapes 6-26, commonly about 15 cm. long: flowers 2-5, commonly 3, calyx-lobes 3-4 mm. long). Maine southward. U. INFLATA Walt. var. MINOR Chapm.
C. Leaves of one or two types, according to type of branches, whether generally associated with scapes or purely vegetative: branches generally associated with scapes always present, these with leaves one or two,

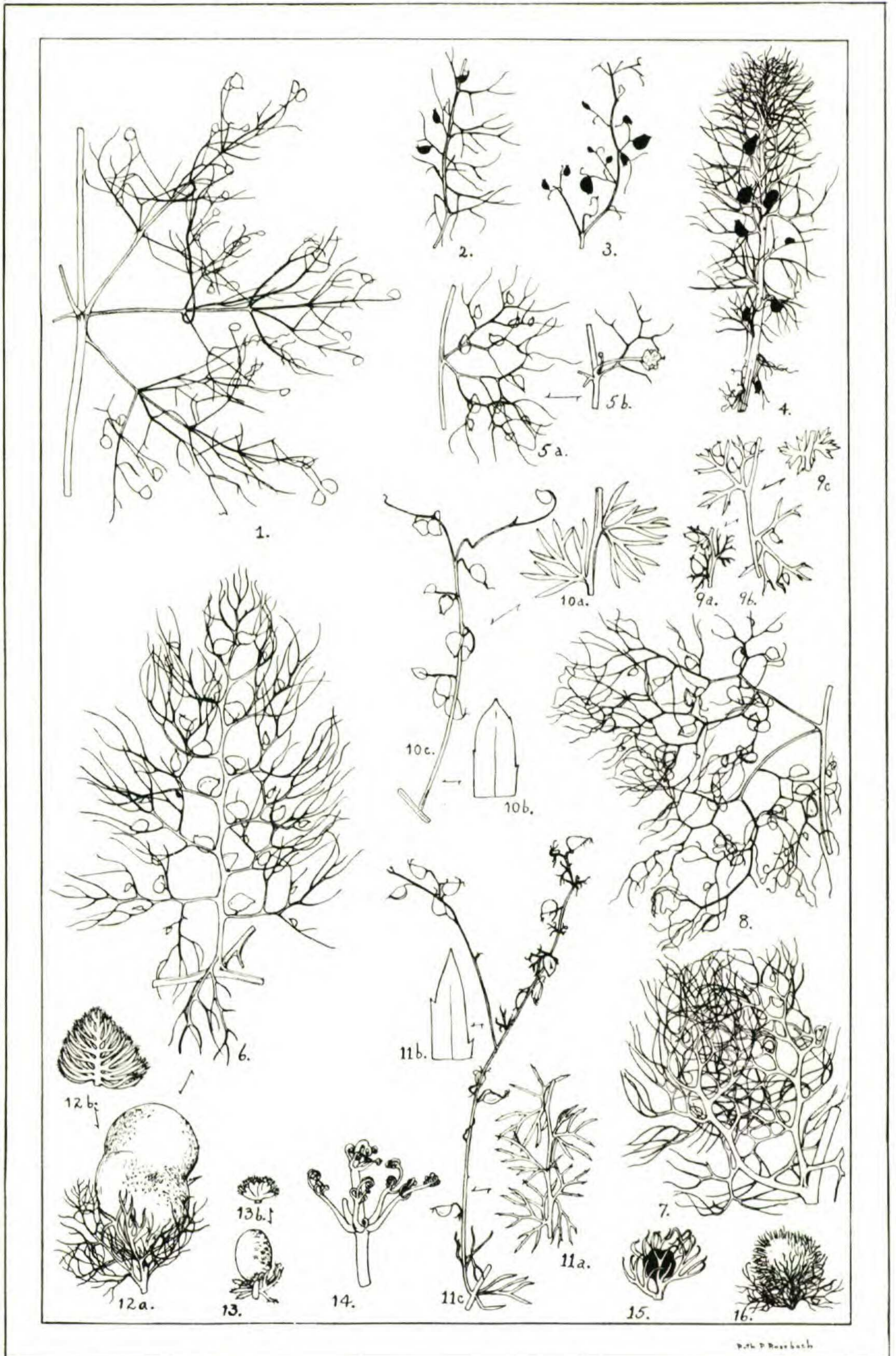
- sometimes three times dichotomous, 2- or rarely a few 3-parted at bases, sparse, and slightly or not at all overlapping; branches of specialized vegetative type usually present on *U. FIBROSA*, these 5-9 cm. long, with crowded leaves nearly all three times dichotomous, basally 2-3-parted, when 3-parted not diverging at one exact point, bladders few or none. . . . G.
- G. Leaves characteristic of branches generally associated with scapes. . . . H.
- H. Leaves once dichotomous, rarely with abbreviated third division, usually not overlapping, bladders scattered, variable in size, and many near ends of leaves. . . . *U. GIBBA* L.
- H. Fully developed leaves twice dichotomous, slightly overlapping, bladders scattered, but generally homogeneous in size (some branches growing under mud having bladder-bearing leaves much reduced in size and dichotomy, thus similar to certain branches on *U. MINOR*) *U. BIFLORA* Lam.
- G. Leaves of both types present, those of specialized vegetative branches as well as of branches generally associated with scapes; bladders most numerous near stems. . . . *U. FIBROSA* Walt.
- B. Foliar divisions flat. . . . I.
- I. Margins of terminal divisions minutely and sharply serrate, leaves bearing few or no bladders, bladders mostly or wholly confined to the always present specialized branches, leaves basally 3-parted, divisions narrow, but usually distinctly flattened, all of one general form. . . . J.
- J. Apices of terminal divisions rounded or nearly so (save for uncommonly delicate condition in deep water), mucronate; bladder-bearing branches having no leaves. . . . *U. INTERMEDIA* Hayne.
- J. Apices of terminal divisions acuminate; bladder-bearing branches having a few small leaves or none. Known only very locally in No. Am. . . . *U. OCHROLEUCA* Hartm.
- I. Margins of terminal divisions entire, leaves all or most bearing bladders, few or no branches specialized for bladders alone, leaves usual 3-parted basally, but some on certain very slender plants 2-parted, altogether of two general forms, one very slender and slightly flattened, bearing a number of bladders (this the common form), the other broadly and distinctly flattened, less dichotomized, more abbreviated, bearing very few or no bladders (this the less frequent form and mostly of shallower water or of spring growth). . . . *U. MINOR* L.

A KEY TO THE WINTER BUDS

- A. Bud an elongate, thickened end of the stem, 1-2 mm. in diameter, bearing crowded, but not closely imbricated, abbreviated and incurled leaves, buds terminating all autumnal branches. . . . *U. PURPUREA* Walt.
- A. Bud a rounded mass of divided, densely crowded, abbreviated and imbricated leaves. . . . B.
- B. Foliar divisions of buds bordered on two sides with stout gray hairs, flattened. . . . C.

- C. Buds 1–2 cm. long, oval, often one-sided or two-parted, composed of very many pseudo-pinnate, severally divided, basally 2-parted, small leaves, divisions of leaves flattened, elongate, narrowly triangular, and bordered with loose tufts of small hairs. U. VULGARIS L.
- C. Buds 3–10, commonly 5–7 mm. long, oval to elliptical, never one-sided or two-parted, composed of many short, broad, few-times-divided, basally 3-parted very small leaves, divisions of leaves much flattened, squamiform-triangular, and bordered with dense tufts of coarse hairs. U. INTERMEDIA Hayne.
- B. Foliar divisions of buds not bordered at all with hairs, bearing but a few setae as on mature leaves, either more or less terete or distinctly and broadly flattened. . . . D.
- D. Buds round or compressed slightly at each end, 1.5–4, sometimes 5 mm. across (in growth and formation unique and quite comparable to the head of a cultivated cabbage, save for the narrow leaves), color reddish green, foliar divisions of completely formed winter bud distinctly flattened. U. MINOR L.
- D. Buds rounded and usually somewhat one-sided and elongate, 5 mm. or much less in diameter, always merging to an attached piece of living stem bearing some leaves, color green, foliar divisions terete. . . . E.
- E. Buds, when present, 2–5 mm. in diameter, formed of loosely integrated, small and slender leaves. (Fruit from cleistogamous flowers common, other fruit rare.) U. GEMINISCAPA Benj.
- E. Buds often not forming, but when present 1 mm. and less in diameter, formed of few, loosely integrated, small leaves, thus scarcely differing from the continually unfolding bud of midsummer: branches and buds, or fruit, forming the next generation. U. INFLATA Walt., U. INFLATA var. MINOR Chapm., U. GIBBA L., U. BIFLORA Lam., U. FIBROSA Walt.

The species under sections E are coastal plain types. Development in them of winter buds is slight or lacking. *U. biflora* and *U. fibrosa* are restricted coastal plain types extending no farther north than southeastern Massachusetts. These two species never develop true winter buds. Winter buds, then, are characteristic of our species occupying regions where they must lie dormant through a long winter. *U. geminiscapa* forms quite unspecialized winter buds, though often growing in very cold climates, but, as a compensation, produces many cleistogamously formed fruits. The species under E-2, with scarcely any development of winter buds, commonly flower and fruit in the usual manner, whereas those species forming specialized winter buds usually bear fewer or even no flowers, and much less commonly produce any fruit. Though *U. purpurea* and *U. vulgaris* are often found flowering and both form some fruit, *U. minor* and *U. intermedia* seem rarely to flower.



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UTRICULARIA: all figs. $\times 1$; for Explanation see end of text.

GEOGRAPHICAL DISTRIBUTIONS AND HABITATS

The geographical distribution of the genus *Utricularia* offers strikingly clear-cut and widely applicable examples of the major plant dispersals of the earth, distributions made most significant by Prof. M. L. Fernald.¹

One group of the genus represented with us is circumboreal (and only two to several of its species grow locally as far south as central Africa and southernmost United States).

The other group, or groups, occupy the North American coastal plain, the southern Great Lakes region, the lower Mississippi River Valley and adjoining lowland areas, and parts of the West Indies, Mexican Plateau, Central America, South America, Australia, Tasmania, Philippine Islands, and Asia, especially in the south, the restricted region about the Mediterranean Sea, and the valleys of, at least, the Nile, Congo, Zambesi, and Niger Rivers of Africa. Many of the areas occupied by this second group are known to be geologically ancient.

The circumboreal group grows typically under water, save for the flowering scape. The group of more southerly dispersal comprises terrestrial as well as truly aquatic forms, and is very diversified. Representative of the circumboreal species are *U. vulgaris* L. and var. *americana* A. Gray, *U. neglecta* Lehmann, *U. minor* L., *U. Bremii* Heer, *U. occidentalis* A. Gray, *U. intermedia* Hayne, and *U. ochroleuca* A. Hartm.

U. vulgaris, including var. *americana*, is frequent in quiet or sluggish water, and in this country known from the Straits of Belle Isle, Labrador and Newfoundland, south commonly through New England and western New York, then becoming less frequent, though occurring, southward to Dade Co., Florida, west, in the north, to Alaska and British Columbia, and in the south, west through Louisiana to Texas and locally to southern California, and present, where habitat is suitable, north and south between these outlined boundaries, especially in the East, the region of the Great Lakes, the Rocky Mountains in general, the Sierra Nevada, Cascades, and Pacific Coast; also in Asia, and in all of Europe.

¹ "Specific Segregations and Identities in some Floras of eastern North America and the Old World," *RHODORA*, xxxiii. 25-63 (1931).

"Recent Discoveries in the Newfoundland Flora," *RHODORA*, xxxv. nos. 409-420 (1933).

"A Botanical Expedition to Newfoundland and Southern Labrador," *RHODORA*, xiii. 109-162 (1911).

U. vulgaris var. *americana* A. Gray is attributed only to North America. However, this supposed variety is scarcely, if at all, separable from true *vulgaris*. The difference, a more slender and rather acute spur on the flower of var. *americana*, seems not to be sufficiently constant nor of sufficient magnitude to justify varietal rank.

U. neglecta Lehm. or, perhaps more wisely, *U. vulgaris* var. *neglecta* (Lehm.) Cosson & Germain is a very close, slender relative of *U. vulgaris*, and it occupies a region with it in Europe. It very often or usually bears well developed branching rhizoid-like shoots extending from very near or at the base of the scape. These outgrowths bear very short, thick, more or less palmate and slightly reflexed processes. On *U. vulgaris*, of this country at least, such growths are almost always diminutive or absent. However, some few forms (often slender, as are plants of *U. neglecta*) in North America bear these growths, occasionally as well developed as they are on *U. neglecta* of Europe.

Examples of *U. vulgaris* with rhizoid-like development in the United States are specimens from South Poland, Maine, collected by *Kate Furbish* in 1894, and from North Berwick, Maine, June 23, 1894, collected by *J. C. Parlin*, both in the herbarium of the New England Botanical Club; and there is pronounced growth of the sort noticeable on a collection by *Louis Williams & Rua Pierson*, no. 1333, July 23, 1933, from the Snake River bottom, Grand Teton National Park, Wyoming, elev. 6700 ft., in herbarium of Calif. Academy of Sciences at San Francisco. Another such collection is one from a muddy lagoon, Charcoal, valley of East River, Pictou Co., Nova Scotia, *Harold St. John*, no. 1450, Aug. 2, 1913, also in herb. of Calif. Acad. Sci.

The proliferations described might seem to be confined to *U. vulgaris* and its close relative, but the writer has observed, also, a case of quite elongate growth on the greatly differing species, *U. occidentalis* A. Gray, on a plant collected from Falcon Valley, Washington, by *W. N. Suksdorf*, July 28, 1883, sheets in herb. of Univ. of Calif. at Berkeley, and Dudley Herb. at Stanford Univ.

The region of Falcon Valley, in western Klickitat Co., Washington, is the type locality of the seemingly endemic *U. occidentalis* A. Gray (type coll. no. 1880 of *W. N. Suksdorf*, described in Proc. Am. Acad. xix. 95, 1883), which is similar to *U. minor* with the leaf-strewn, bladder-bearing branches, but the winter buds are not formed of obvious smooth leaves as in *U. minor*, but are composed of the hair-tufted,

scale-like foliar modifications characteristic of *U. intermedia*. Gray describes *U. occidentalis* as between these two species, and the resemblance is true of the leaves, which do range from the type of one species to that of the other, appearing as in either, as well as intermediate between the two, though more often as in *U. intermedia*. Such a combination of two different specific characters in one entity is noteworthy. *U. occidentalis* grows in a region not remote from both *U. minor* and *U. intermedia*.

A group of related species includes *U. intermedia* Hayne, *U. ochroleuca* A. Hartm., *U. minor* L., and *U. occidentalis*. The leaves, or at least what appear superficially to be leaves, of this group are typically three-parted at the base and flattened, as opposed to the leaves of the wholly differing group to which *U. vulgaris* belongs, which are parted twice basally, terete, and uniquely pseudo-pinnate. Both of these lesser groups are of a circumboreal distribution, however.

U. intermedia and its relatives bear bladders, not equally distributed upon all mature leaves as does *U. vulgaris*, but somewhat localized. Bladders are more or less present throughout the whole plant of *U. minor*, but, to an extent, in this species, and much more so in *U. occidentalis* and *U. ochroleuca*, are they abundant only on specialized branches bearing diminutive leaves. In *U. intermedia* there is a specialization of the characteristically larger bladder-bearing branches without leaves, whereas upon the foliar stalks there grow no bladders at all. The last is a well known species in shallow pools of bog-water and margins of boggy ponds and sloughs about the boreal portion of the earth.

In North America *U. intermedia* is distributed from the west coast of Greenland and from Newfoundland south to New Jersey and Pennsylvania, west, in the north, at least to British Columbia, and in the south, ranging west to Indiana, Illinois, Iowa, and further west only at higher altitudes to the Pacific States.

This distribution is of interest geographically in its relation to glaciated areas. As the species occupies boggy country of the northeastern, northern, and highland regions just outlined, it is, therefore, restricted to areas more or less glaciated during the Wisconsin period of ice-cap formation.

U. minor, though not by any means strictly a plant of bogs, has a similar geographical range in North America, from Disko, west coast of Greenland (specimen delicate and somewhat atypical, Gray

Herbarium) and from Blanc Sablon, Straits of Belle Isle, Labrador south through Newfoundland, St. Pierre et Miquelon, Magdalen Islands, Anticosti, Gaspé, Prince Edward Island and Nova Scotia, south inland through all of New England to western New York, and on the coast to Long Island and New Jersey, and west, in the north to the Mackenzie Basin (*H. M. Raup*, no. 3138), and at least to British Columbia, and in the south, growing west to the region of the Great Lakes, then locally at higher altitudes to the Pacific States. It is also in northern Asia and generally throughout Europe.

The range, at least in North America, with some local exceptions in the Northeast, covers partially glaciated areas. *U. vulgaris*, covering the same range, occupies, besides, the central plains and extends much further southward.

In Europe a species related to *U. minor*, called *U. Bremii* Heer, is recognized. This surely seems, from study of a number of specimens and from description, to be *U. minor* or, at best, no more than a variety of it, to which it was first relegated by Franchet. Morphological differences do not stand out.

Near *U. intermedia* is a species, *U. ochroleuca* A. Hartm., which bears leaves with acuminate rather than blunt and mucronate divisions, as does *U. intermedia*. Furthermore, the bladder-bearing branches may have a few leaves, a condition not true of its relative. In the Gray Herbarium at Harvard University one finds *U. ochroleuca* represented from East Prussia and locally southward through the rest of Germany. It has been considered an Old World species. Thus it is noteworthy that *Perry & Roscoe*, on July 23, 1929, collected *U. ochroleuca* at Lena Lake, St. Paul I., Nova Scotia. Collections are in the Gray Herbarium as follows: *Perry & Roscoe*, no. 351 a, July 23, 1929, and no. 351, Aug. 10, 1929.

So much for the circumboreal group, and now to turn to those of more southerly, and, individually, rather more limited distributions.

Among the Utricularias of the groups especially occupying the Atlantic coastal plain of America are a number of terrestrial species usually growing in wet sand or peat, but also among the plants of this distribution are many aquatic species, the northeastern American members of which are *U. purpurea* Walt., *U. inflata* Walt., *U. inflata* var. *minor* Chapm., *U. gibba* L., *U. biflora* Lam., *U. fibrosa* Walt., and *U. geminiscapa* Benj. These obviously do not comprise a homogeneous group morphologically, but merely share a generally similar geographical range.

Among all the species in North America *U. purpurea* is unique. The leaves are whorled. The winter bud is a thickened end of a stem bearing abbreviated, incurled, and uniquely remote leaves, whereas specialized buds of other species are more or less rounded masses of closely imbricated leaves or leaflike scales upon a very short axis.

U. purpurea Walt. is common in ponds and sluggish, but generally not extremely shallow water. It occupies a wide range north and south, recently found to be more extensive than formerly known: Montreal Co., Quebec, south through Nova Scotia and New Brunswick and the Atlantic coastal states to Florida; Mississippi, Louisiana; northern Indiana and Michigan to Minnesota; Cuba; British Honduras.

In Montreal Co., Quebec it grows near the city of Montreal, and therefore in the low valley proper of the St. Lawrence, as is to be expected of a generally coastal plain plant extending northward. The isolated representation from British Honduras was collected at All Pines by *W. A. Schipp*, no. 608, Sept. 1, 1930, specimens observed in the Gray Herbarium and at the University of California at Berkeley.

A single relative of *U. purpurea* in the New World is *U. myriocysta* St. Hil. & Girard. Both species have whorled leaves and purple flowers. In the Gray Herbarium *U. myriocysta* is represented only from British Guiana.

U. inflata Walt. and its var. *minor* Chapm. are recognizable by the single whorl of inflated, petiole-like processes radiating from the base of the flowering scape which usually appears annually. The leaves are not whorled, but arranged as are those of most aquatic species. Var. *minor* Chapm. (*U. radiata* Small) is distinguishable from typical *inflata* in that the basal divisions of the leaf are longer and much more slender throughout the plant (for comparative measurements see key), in the generally shorter, fewer-flowered scapes, and in the smaller size of the plant and all its parts.

It is noticeable, then, that all the many collections of *U. inflata* from the northeastern United States are not of typical *U. inflata*, as is most often supposed, but are of Chapman's variety *minor*.

Typical *U. inflata* is a plant of the Southern States only. It has been collected from quiet water on the southern Atlantic coastal plain and the lower Mississippi Valley region, which is known to be a related area botanically. From Florida it is represented from Duval, Volusia, Pinellas, Lee, and Brevard Counties, from Screven Co., Georgia, and locally from South Carolina. There is one record as far north as

Grassfield, Norfolk Co., southeastern Virginia, *Fernald & Griscom*, no. 4501, May 7, 1935, in Gray Herbarium. Collections have also been studied from Madison Co., western Tennessee, Cherokee Co., eastern Texas, and Sansaba Co., central Texas. This robust plant only occasionally intergrades with variety *minor* in the generally diagnostic foliar character mentioned and in size.

The range of var. *minor* is disrupted, it having been collected from Hancock, Waldo, and Franklin Counties of Maine, south near the coast commonly to New Jersey, then becoming very local, if not lacking, southward, reappearing in pine barrens of Duval, Lake, Brevard, and Polk Counties, Florida, and collected at least once from near the Paraguay River and Concepcion, Paraguay, and from Santarem, on the Amazon River, Brazil, by *R. Spruce*.

The strikingly isolated plants from South America have quite the appearance of *U. inflata* var. *minor* as concerns all gross morphology of herbarium specimens, at least. The collection by *R. Spruce* from Santarem was first named as a separate species, *U. quinqueradiata* Spruce ex Oliver in *Journ. Linn. Soc.* iv. 171 (1860). No description is there given other than the following:

“No. 1053 *U. quinqueradiata* (Spruce's MSS.). Santarem.—I regard this as a small form of the *U. inflata*, Walt., of the North American continent. Specimens from Florida (Rugel, coll.), labelled *U. inflata*, var. *minor*, do not seem different.”

There is no reason to doubt this statement, despite geographical separation; the plants of both continents are probably the same.

It is of interest that at least one other species, *U. stellaris* L., bears inflated petiolar growths as does *U. inflata*, though it differs in the sacs being shorter and all the leaves being whorled. This plant is represented in the Gray Herbarium from the valleys of the Nile, Congo, and Niger Rivers of Africa, and from Malabar on the southeast coast of India, and is known to grow elsewhere in both Africa and India.

A North American coastal plain dispersal of quite expanded sort northward is to be found in the range of *U. geminiscapa* Benj. (*U. clandestina* Nutt.). *U. geminiscapa*, with its delicate leaves of rounded outline and twin bases and its commonly occurring cleistogamous and fruiting flowers, is frequent in ponds and bog-pools of the northeastern coastal plain and related or adjacent areas: western Newfoundland; Magdalen Islands of Quebec; Nova Scotia; Hancock and Waldo

Counties, Maine, south chiefly near the coast to Delaware and Pennsylvania. A quite isolated southern locality is represented by the collection of *Fernald & Long*, no. 4187, July 28 and 29, 1934, from Cape Henry, Princess Anne Co., southeastern, Virginia. The species grows isolated inland in Orleans Co., Vermont, and it occurs in a sandy region of the Connecticut Valley in Hampden and Berkshire Counties of western Massachusetts. Vilas Co., Wisconsin is another noteworthy isolated area represented.

Other coastal plain plants, including *Utricularia gibba*, are commonly reported from this region of the Connecticut Valley of Massachusetts; and to find coastal plain affinities in the southern Great Lakes region is, of course, an old story, but an ever expanding one as regards the generally coastal Utricularias of that area.

Similarly, such plants as *U. geminiscapa* may extend to the northeast not only via Cape Cod and Nova Scotia, and even to western Newfoundland, as Prof. Fernald points out, but may, as is known, even follow the inner coast, that is, of Maine, more remote from the eastwardly sunken coastal plain. *Chamaecypris thyoides* grows more and more locally eastward on the coast to York Co., Maine, reappearing in Waldo and Knox Counties, whereas some other similarly distributed plants meet the boreal types as far east as Mt. Desert Island. It is of interest, but not surprising, then, that Utricularias of the expanded coastal plain dispersal should be common in these many named areas outside the true Atlantic coastal plain.

Though *U. geminiscapa* does not seem to have been collected from British Honduras, a very similar plant, but with "flowers deep rose colour" instead of yellow was collected by *W. A. Schipp* at All Pines, British Honduras, no. S 90, Sept. 2, 1930, in herbarium of Univ. of Calif. at Berkeley. It was at All Pines that Schipp collected the northern coastal *U. purpurea* cited above.

U. gibba L. is a fine example, in its distribution, of the coastal plain groups. It is not restricted to the coast, but much commoner near it, known from Megantic Co., Quebec, Lunenburg and Yarmouth Counties, Nova Scotia, and Maine, south to Florida and west to Louisiana, near the Gulf Coast, also Ouachita Parish, valley of Washita River, northern Louisiana; isolated in western Vermont, Hampden and Berkshire Counties of the Connecticut Valley in western Massachusetts, and western lowland New York to southern Ontario, Michigan, Wisconsin, Ohio, Indiana, Illinois, and, according to Gray's Man.,

7th ed., in Minnesota (specimens not observed from Minn.). Isolated collections come from Tennessee, and from Tarrant Co., northern Texas, and specimens probably of this species have been observed from elsewhere in Texas and north into Oklahoma. *U. gibba* is also in California. Plants seemingly of this species appear from the Bahamas, Porto Rico, Mexico, and, again, British Honduras.

The generally once-dichotomous, very delicate leaves of but one type, with many bladders, especially near ends of leaves, as characteristics serve fairly well to distinguish the vegetative plants of *U. gibba* from other North American species, and when it is in flower, as is frequent, the noticeably small, laterally flaring corollas further decide determination.

It is noteworthy that just such specimens as described above of this once supposed eastern coastal plant appear in collections from California, most of them properly identified as *U. gibba*. At least, complete morphological characters observed in pressed material (and some fresh) point definitely to that species. H. L. Mason published an article on the occurrence of *U. gibba* in California in Madroño, ii, p. 23 (1931), and I find that most of the following citations of collections observed by the writer were first noted by Dr. Mason in his article. Citations of sheets studied are as follows: Bogg's Lake, Mt. Hannah, 2500 ft., Lake Co., *J. W. Blankinship*, Sept. 10, 1928, in herb. Calif. Acad. Sci.; slough at Holt, San Joaquin Co., *John Thomas Howell*, no. 4411, Sept. 21, 1929, in herb. Calif. Acad. Sci.; irrigation ditch, Stockton, San Joaquin Co., *Walton Clark*, Aug. 26, 1923, in herb. Calif. Acad. Sci.; ditch 3 mi. southeast of Santa Rosa, Sonoma Co., *M. S. Baker*, Nov., 1898, in herb. Univ. Calif. at Berkeley; Swamp Lake, 5200 ft., Tuolumne Co., *H. L. Mason*, no. 11593, July 23, 1937 (aquatic form with no flowers, and emersed form from floating log), bearing flowers in herb. Univ. Calif. at Berkeley. Thus a marked addition to the once supposed range was brought to light.

U. biflora Lam. and *U. fibrosa* Walt. are close to each other and both in the *U. gibba* relationship according to appearances. *U. fibrosa* seems characteristically to bear several purely vegetative branches crowded with comparatively large leaves which are nearly all three times dichotomous and supporting very few or no bladders. *U. biflora* differs vegetatively from *U. fibrosa* in seemingly not having these specialized vegetative branches. The fully developed leaves of *U. biflora* (and those of unspecialized branches of *U. fibrosa*) are some-

what larger than those of *U. gibba* and are twice dichotomous, whereas leaves of *U. gibba* are once dichotomous, rarely with an abbreviated third division. The flowers of *U. gibba* are distinctly smaller than those of *U. fibrosa* and than almost if not quite all those of *U. biflora*, and the spur of *U. gibba* is distinctly shorter than that of the two relatives.

The geographical distributions of *U. fibrosa* and *U. biflora* are very similar but cover only a portion of the range of *U. gibba*, being restricted, at least northward, to the coastal plain area itself, extending locally in ponds north only to southeastern Massachusetts, along with a number of better known but similarly restricted plants. Judging only from well collected sheets, *U. biflora* is represented from Barnstable Co., Massachusetts south near the coast to Florida; Mississippi to Texas and north into Oklahoma; also probably south of the United States.

U. fibrosa reveals records from certain ponds of Plymouth, as well as Barnstable Counties, Massachusetts; Long Island, New York, and New Jersey, south, probably locally, to Florida; Alabama and Mississippi; also possibly south of the United States.

Subtropical and tropical Utricularias of the *gibba-biflora* relationship grow in parts of the West Indies, Mexico, Central and South America. These include imperfectly known species, more or less similar to each other and to *U. gibba* or to *U. biflora*. Due to few and incomplete specimens final statements of the taxonomic or local geographic situations concerning these seem at present to be impossible. And, eventually, careful synoptical work will be necessary on the group from the southern United States southward.

It seems probable that species of this relationship, but not discussed here, extend northward as a subtropical complex into the Gulf States and possibly westward in the lower valleys. But probably *U. gibba*, *U. biflora*, and *U. fibrosa* are the only species of such a relationship to be found in the area covered by Gray's Manual.

Because it is well outside the Manual range a certain whole group of strikingly distinct aquatic Utricularias, those of the *U. oligosperma* relationship, extending north to peninsular Florida and the Gulf Coast, has been here omitted from consideration. One species is known from southern Florida to Louisiana. These aquatics are large plants with excessively ramified, elongate, bladderless leaves and elaborate, specialized, leaflike branches dispersed among them (and

not at their bases) and bearing many bladders. Such a form of plant is outwardly similar to no other group of the genus.

Finally, a discussion might be devoted to qualities of the habitat of North American Utricularias. All species of the Atlantic coastal plain dispersal grow in what would seem to be only acidic waters or soils, usually in sandy and boggy localities.

U. gibba, *U. biflora* and *U. fibrosa*, of peaty or somewhat sandy pond-shores, nearly bridge, in habitats, the aquatic with the truly terrestrial species. *U. biflora* commonly becomes stranded or nearly so, and when in this condition will develop pale branches just beneath the mud, somewhat as does *U. cornuta* of boggy or wet sandy ground, save that the leaves on such branches are not the erect, slightly emerging, and simple leaves of *U. cornuta*, but are, in form, essentially like the usual ones of *U. biflora*, being merely reduced in size. Bladders are always borne on such leaves, and the appearance of these branches is much like certain similar growths more common to *U. minor*.

Upon becoming stranded in late summer, flowering of these three species is usual. *U. gibba*, though often growing in tangles or rafts fairly well off shore (as well as very near shore), fully as commonly as *U. biflora* becomes stranded also; and it can grow, it would seem, to better advantage thus than *U. biflora*. Flowering usually becomes profuse. The few radiating stems subtending a scape will dry up, yet the plant persists with the habit of, say, the terrestrial *U. resupinata*. *U. gibba*, especially, may be found in either aquatic, and then usually vegetative, condition or in terrestrial and fruiting phase, and the habit may be in all stages between the two forms according to environment, yet obviously the same species. The neighboring Myriophyllums behave quite similarly.

Among the circumboreal species there is no general preference toward acidic or basic waters. *U. vulgaris* is common in all circumneutral or somewhat acidic waters of its range, and some specimens from the Great Plains and the Southwest are encrusted with alkaline deposit.

U. minor, however, despite possible and seeming exceptions, shows preference for basic waters, often growing in ponds washing a calcareous bed. And, as local New England collectors can testify, *U. minor* may even grow in alkaline tidal inlets, such as Winnegance Creek, Phippsburg, Sagadahoc Co., Maine, and creeks at Falmouth, Massachusetts, in which cases growth is variously and oddly modified. (See herb. New England Bot. Club.)

The writer has most commonly found *U. minor* in water proximate to more or less calcareous rock, yet he has also found it in the open, deeper places and thoroughfares through sphagnous bogs, generally supposed to be an acidic habitat by field botanists. Such a habitat is to be found in the deeper, open water of the thoroughfare through Knights Bog, foot of Pitcher Pond, Northport, Waldo Co., Maine. Nearby, *U. intermedia* and *U. geminiscapa* grow in the bog-bound, shallow pools not occupied by *U. minor*.

In one instance noted by the writer *U. minor* grew in water of a deep bog, and was near *Sphagnum*, *Chamaedaphne*, etc., but in close company with *Nitella*. This was on the bottom, not the shallow sphagnous margin, of a spring-fed pool (near Beaver Pond, Lincoln, Massachusetts). *U. minor*, however, in no case grew in the smaller, stagnant pools intimately surrounded by the acid-loving and acid-creating *Sphagnum*, as is often the case with the similar *U. intermedia*, and true, as well, of the quite differing *U. geminiscapa*. The pool in question being rather deep and partially fed by an underground flow might well have had both basic and acidic habitats for plants, the basic tending to dominate below. This condition, as a guess, may also have been true in the case of *U. minor* growing in the deep center of the slough in a sphagnous bog.

U. intermedia generally occupies acidic water throughout its range in this country, and yet, occasionally, it is collected from a marl bog: "In marl, edge of Meadow Lake," valley of the Limestone River, Fort Fairfield, Aroostook Co., Maine, *M. L. Fernald*, 1898, Gray Herb. To certain other such seeming aberrancies in Aroostook County Prof. Fernald has already called attention.

But the water, altogether testing as acidic or basic either, of course constitutes no absolute or accurate indication of the actual chemicals needed and used by plants growing therein. Physiological study of chemical requirements for certain Utricularias might explain the seemingly unusual habitats.

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EXPLANATION OF FIGURES

UTRICULARIA PURPUREA: FIG. 1, a whorl of leaves on stem, showing only the bases of two of the divisions; FIG. 14, winter bud, showing fleshy winter-resistant portion with its incurled leaves.

U. BIFLORA: FIG. 2, portion of stem bearing leaves.

U. GIBBA: FIG. 3, portion of stem bearing leaves.

U. FIBROSA: FIG. 4, specialized vegetative branch.

U. GEMINISCAPA: FIG. 5 a, a leaf; FIG. 5 b, a cleistogamous fruit (split open by pressure); FIG. 16, winter bud.

U. VULGARIS: FIG. 6, a leaf, showing only the base of one half; FIG. 12 a, winter bud; FIG. 12 b, foliar modification from winter bud, $\times 5$.

U. INFLATA: FIG. 7, a leaf.

U. INFLATA, var. MINOR: FIG. 8, a leaf.

U. MINOR: FIGS. 9 a & b, portions of stems from two plants showing two common forms of 3-parted leaves; FIG. 9 c, portion of stem bearing two 3-parted leaves of the less frequent, short, broad and bladderless form, especially of vernal growth from winter buds or of nearly terrestrial plants; FIG. 15, winter bud, with the usually somewhat incurved subtending leaves.

U. INTERMEDIA: FIG. 10 a, portion of stem bearing the 3-parted leaves; FIG. 10 b, apex of a terminal foliar division, $\times 5$; FIG. 10 c, specialized bladder-bearing branch; FIG. 13, winter bud; FIG. 13 b, foliar modification from winter bud, $\times 5$.

U. OCHROLEUCA: FIG. 11 a, portion of stem bearing leaves; FIG. 11 b, apex of a terminal foliar division, $\times 5$; FIG. 11 c, bladder-bearing branch.

All figures natural size unless otherwise indicated.

SOME RECENT ADDITIONS TO THE FLORA OF BERKSHIRE COUNTY, MASSACHUSETTS

GEORGE J. WALLACE

In spite of the thirty years of exploration and research that is back of Hoffman's admirable *Flora of Berkshire County*,¹ a census of the flowering plants occurring at the Pleasant Valley Bird and Wild Flower Sanctuary in Lenox during the spring and summer of 1938 disclosed additional species that seem well worth recording. But for two interesting exceptions, these new species, as might be expected, consist of exotics, presumably introduced since the publication of Hoffman's work. Mention should also be made of several other plants which, though known in the region before, have changed their status markedly in the last decade or two.

Census work was confined to the Sanctuary grounds, a 306-acre tract of land comprising old meadows, marshes, alder swamps, and the deep cool woods of a mountainside. The whole area ranges in elevation from 1200 feet in the valley of the included trout stream to 1800 feet at the summit of Lenox Mountain. To the wealth of plant species naturally occurring in such a diversity of habitat may be added many deliberate as well as accidental introductions—bog species in the artificial bog, woodland plants in the Fernery, berry-producing shrubs planted to encourage birds, and a great number of unforeseen

¹ Hoffman, Ralph, *Flora of Berkshire County, Massachusetts*. Proc. Boston Soc. Nat. Hist. Vol. 36, No. 5, 1922, pp. 171-382.